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MEMORANDUM REPORT ARBRL-MR-03128

BURNING RATE DATA, LGP 1845

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August 1981

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: MEMORANDUM REPORT ARBRL-MR-03128 (14) 2. GOVT ACCESSION NO.: AD-A104637	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): BURNING RATE DATA, LGP 1845 (6) (9)	5. TYPE OF REPORT & PERIOD COVERED: FINAL [illegible]
7. AUTHOR(s): (10) WILLIAM F. McBRATNEY	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: U.S. Army Ballistic Research Laboratory ATTN: DRDAR-BLI Aberdeen Proving Ground, MD 21005	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (16) 1L161102AH43
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Armament Research & Development Command U.S. Army Ballistic Research Laboratory ATTN: DRDAR-BL Aberdeen Proving Ground, MD 21005	12. REPORT DATE: AUGUST 1981 (11) (12) 14 13. NUMBER OF PAGES: 12
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Liquid Propellant
Burning Rate
LGP 1845

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Burning rate data were obtained for the liquid propellant LGP 1845 over the pressure range of 10 MPa to 100 MPa.

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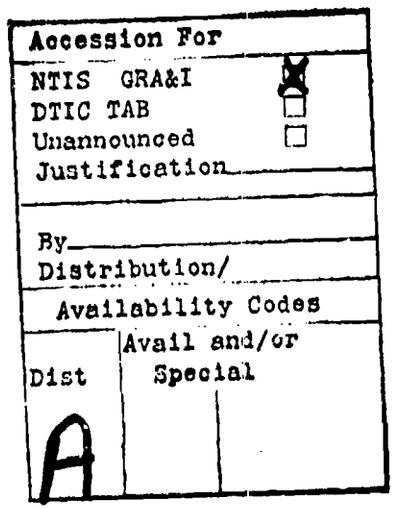

I. INTRODUCTION

As a part of the liquid propellant gun program, various candidate propellants are being tested for a range of properties. During closed chamber tests, a propellant identified as LGP 1845 was determined to have a "visible transition" near 20 MPa.[1] It was requested that burn rate data be obtained for this propellant in the isobaric windowed chamber[2] and that observation be made on the luminosity above the burning surface of the propellant.

II. DISCUSSION

Previously, work has been done on obtaining burning rate data on liquid propellants in windowed chambers. By gelling the propellant and burning it in rectangular cross-sectioned cells, photographic observation of the burning propellant under nearly planar conditions may be obtained. By making the sample holder thin in the direction of observation, surface disturbances greater than 0.1 mm may be observed.

A sample of LGP 1845 was gelled with 2% (wt) Kelzan.* Sheet acrylic sample cells were acquired for the rate tests. These rectangular cross-section cells were 1.5 mm by 6 mm in section.[2]

A video tape system+ was used to record the burn data. A millimeter scale was positioned behind the sample. Sample ignition was by a hot nichrome wire at the surface.

The surface of this propellant, burning in the acrylic cells, has the appearance of plane segments inclined to the axis of the cell. The burn front is fairly flat but it is tilted relative to the axis of the cell as in Figure 1. This tendency has been observed with other propellants.[2] The burning rate data have been corrected for surface inclination by a cosine correction factor for burning rate as determined by the observed angle of the burning surface. It has been assumed that the burning occurs along a perpendicular to the gelled propellant surface. $R = V \cos \theta$.

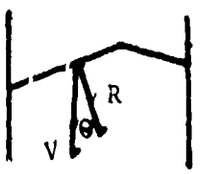

Figure 1. Inclined Burning Surface

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[1] *Kenton Travis, BRL personal communication, April 1980.*

[2] *William F. McBratney, "Windowed Chamber Investigation of the Burning Rate of Liquid Monopropellants for Guns", ARBRL-MR-03018, April 1980. (AD #A086106)*

**Kelzan is a polysaccharide gelling agent from the Kelco Company.*

+The video tape was a Sony AV8600 with standard interlace timing (60 Hz).

Samples were burned over the pressure range of 7 MPa to 100 MPa. Figure 2 is a plot of the reduced data for these tests. In the neighborhood of 60 MPa, the acrylic cells began to be disrupted during the test, and polypropylene straws were used for the higher pressure tests. The slope change observed at pressures above 60 MPa occurred at pressures where the acrylic cells were being damaged and the polypropylene straws had to be used. The data above 60 MPa should not be interpreted as planar burn rate data until better photographic observations are obtained.

Luminosity observations were made with the video tape system. At 7 MPa, no luminosity was observed above the propellant sample. At 10.3 MPa, flashes of luminosity were observed as streamers fluctuated in position and duration. At pressures of 60 MPa and higher, the luminosity was very bright and appeared continuous.

In order to see if the burning propellant was reacting with the acrylic cell to produce the luminosity, a sample was burned in a glass tube at 60 MPa. The luminosity obtained in this test appeared to be comparable with luminosity obtained in tests using acrylic cells.

III. CONCLUSIONS

In this sequence of tests the rate data curve was not observed to have a change in slope until pressures above 60 MPa were reached. The variation originally encountered by Travis near 20 MPa corresponds to a change in flame luminosity which is first observed as luminous streamers at 10.3 MPa.

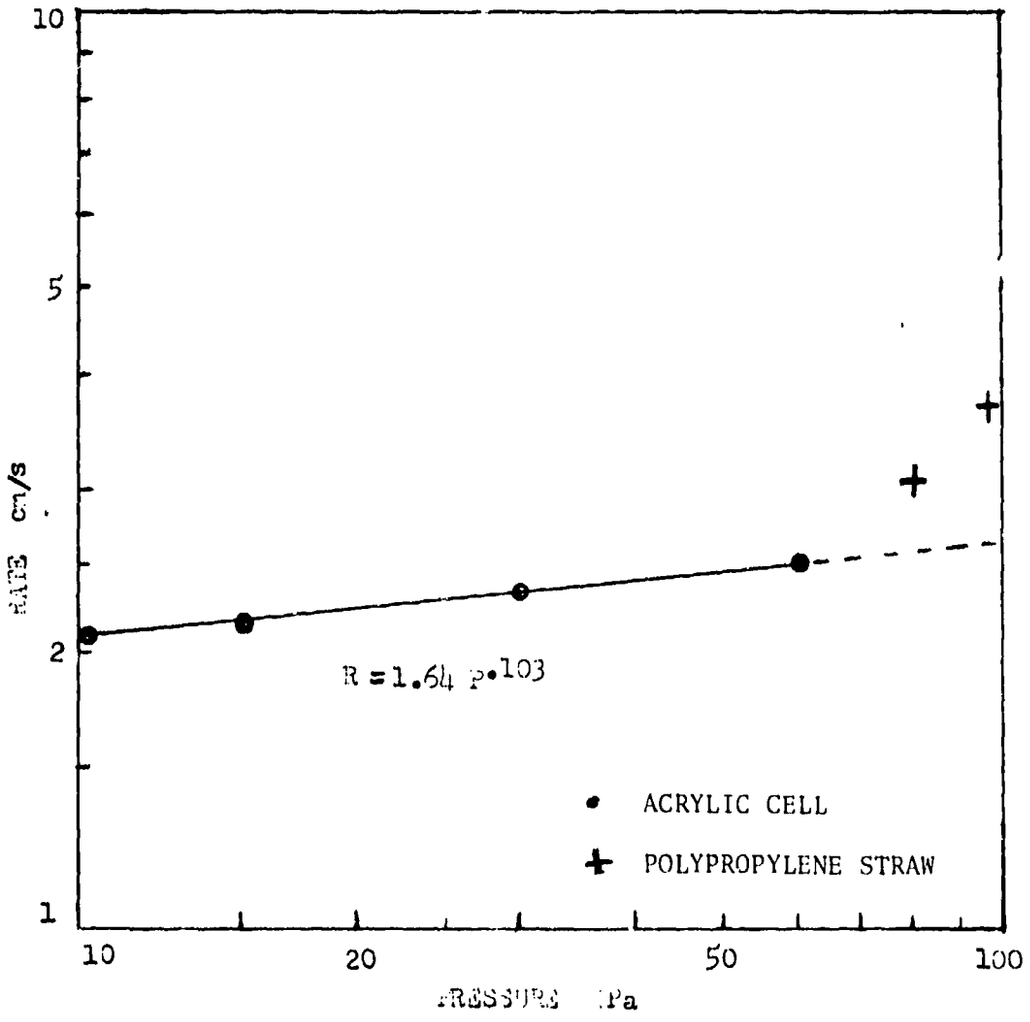

Figure 2. Burning Rate, LGP 1845 2% Kelzan Gel

REFERENCES

1. Kenton Travis, BRL personal communication, April 1980.

2. William F. McBratney, "Windowed Chamber Investigation of the Burning Rate of Liquid Monopropellants for Guns", ARBRL-MR-03018, April 1980. (AD #A086106).

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